DEVELOPMENT OF REAL-TIME SOLAR MONITORING SYSTEM

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"I hereby acknowledge that the scope and quality of this thesis is qualified for the award of the Bachelor Degree of Electrical Engineering (Power System)"

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Date : _____23 NOVEMBER 2009_____

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May Allah reward His peace and blessings to all of you, and may this work brings benefit to the mankind.

ABSTRACT

Solar energy is the light and radiant heat from the Sun that influences Earth's climate and weather and sustains life. Solar power is synonym with solar energy or more specifically to refer to electricity generated from solar radiation. Solar energy technologies can provide electrical generation by heat engine to use for space heating and cooling in active and passive solar buildings; potable water via distillation and disinfection, day lighting, hot water, thermal energy for cooking, and high temperature process for industrial purposes. Even all of us know about this useful energy, but awareness of researcher about this energy still low level in Malaysia. There are many useful application can designed to sure this energy able to use with more efficient. Due to that awareness, a system that can show the solar panel parameter, like the voltage, current, power produced will be develop. This system used Visual Basic Studio 6.0 software and a hardware circuit to convert the signal from solar panel to a digital signal. This project used Microcontroller Programmable Intelligent Circuit (PIC) 18F4550 as their controller circuit. This PIC18F4550 will control the all the analog input from current sensor and voltage divider then convert it into digital signal before pass through the Universal Serial Bus (BUS), then receive by Visual Basic Studio 6.0. Voltage, current and power value will be displayed at GUI at Visual Basic Studio. This system also has built in database system to record all the data entered.

ABSTRAK

Tenaga solar adalah cahaya dan radiasi haba dari matahari yang mempengaruhi iklim bumi, cuaca dan keupayaan untuk hidup. Kuasa solar adalah sama maksud dengan tenaga solar atau dengan lebih tepat merujuk kepada tenaga elektrik yang dijana oleh radiasi solar. Teknologi tenaga solar boleh menjana elektrik yang digunakan mesin haba untuk memanaskan ruang dan penyejukkan aktif dan pasif dalam bangunan yang digunakan tenaga solar; air bersih melalui pembersihan atau penyahjangkitan; lampu siang; pemanas air; tenaga haba untuk memasak dan proses yang menggunkan suhu tinggi dalam industry. Walupun kebanyakan kita tahu tentang bergunanya tenaga ini, tetapi kesedaran di kalangan pengkaji di Malaysia tentang tenaga ini masih di tahap yang rendah. Pelbagai aplikasi yang berguna boleh direka untuk memastikan tenaga ini boleh digunakan dengan lebih berkesan. Atas kesedaran ini, sebuah sistem yang boleh mempamerkan nilai tenaga keupayaan, arus dan kuasa dibangunkan. Sistem ini menggunakan perisian Visual Basic Studio 6.0 dan litar untuk menukarkan isyarat dari panel solar kepada isyarat digital. Projek ini menggunakan *Microcontroller Programmable Intelligent Circuit* (PIC) 18f4550 sebagai litar pengawal. PIC18F4550 ini akan mengawal isyarat analog dari sensor arus dan pembahagi tenaga keupayaan kemudian mengubah isyarat tersebut kepada isyarat digital sebelum melepasi *Universal Serial Bus* (USB) dan kemudian diterima oleh Visual Basic Studio 6.0. Nilai tenaga keupayaan, arus dan kuasa akan terpamir pada GUI pada Visual Basic Studio 6.0. Sistem ini juga mempunyai sistem maklumat dalaman yang mampu merekod semua data yang masuk.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

μ	-	Micro
A	-	Ampere
F	-	Farad
GND	-	Ground
Hz	-	Hertz
Hz	-	Hertz
I	-	Current
M	-	Mega
R	-	Resistor
V	-	Voltage
Watt	-	Power
Ω	-	Ohm

LIST OF ABBREVIATIONS

AC	-	Alternate Current
ADC	-	Analog to Digital Converter
DC	-	Direct Current
EPROM	-	Erasable Programmable Read-Only Memory
GUI	-	Graphic User Interface
I/O	-	Input / Output
LCD	-	Liquid Crystal Display
PIC	-	Programmable Intelligent Circuit
PROM	-	Programmable Read-Only Memory
PV	-	Photovoltaic
R	-	Resistor
RAM	-	Random Access Memory
ROM	-	Read Only Memory
USB	-	Universal Serial Bus

LIST OF APPENDICE

CHAPTER 1

INTRODUCTION

1.1 Introduction

Day and another day, month and another month, year and another year, worlds have changed. The technologies of solar now lead us to a new technology of green power. Nowadays there are many of green power was discovered from sun until earth and one of the green power is currently discussed is solar energy. Solar energy is an energy generated from light and radiant from the sun that's produced electricity energy. By producing that energy, world now can reduce depends on the electricity energy produced from non-renewable energy for example petroleum, coal and the latest nuclear energy. With the technology of solar energy, world now can smile but the research for long time usages is needed to make sure that we can get more benefit from this energy. Now researches about solar energy more focus on efficiency of usage this energy. One of the ways is by put the monitoring system that displayed voltage and current produced at solar panel systems. By monitoring this solar panel system we can plan our usage of electricity energy for future planning.

So, from this issue, I have developed a Real Time Solar Monitoring System by using Visual Basics Studio.

1.2 Objective of Project

1. Design systems that can easier the analysis process for solar panel systems.
2. Record the data of voltage and current produced from solar panel system.
3. Use the data for make analysis for future planning usage of electricity energy.

1.3 Scope of Project

In this project, it is contain both part of hardware module and software module.

For the software module, Visual Basics Studio software will be use to show voltage and current value. Visual Basics Studio contains GUI part and programming part. In GUI part, it will show both value current and voltages produced and for the programming part it is contain the program that designed for run this process in Visual Basics Studio software.

Besides, the programming also need in PIC microcontroller for controlling that circuit. This process include design the program, compile the program and burn that program into PIC 18F4550.

In hardware part, PIC 18F4550 microcontroller will be used. By interface current sensor and voltage sensor with PIC microcontroller circuit, it will convert the current and voltage that flow from solar panel to digital signal then that digital signal will be

process in PIC 18F4550 before that signal pass through to Visual Basics Studio using Universal Serial Bus (USB).

1.4 Summary of Project

Developing of this project from the first step until the final step is summarized in the figure 1.0 and figure 1.1 shows the details of process of this systems. This summarized was covered from first semester until second semester.

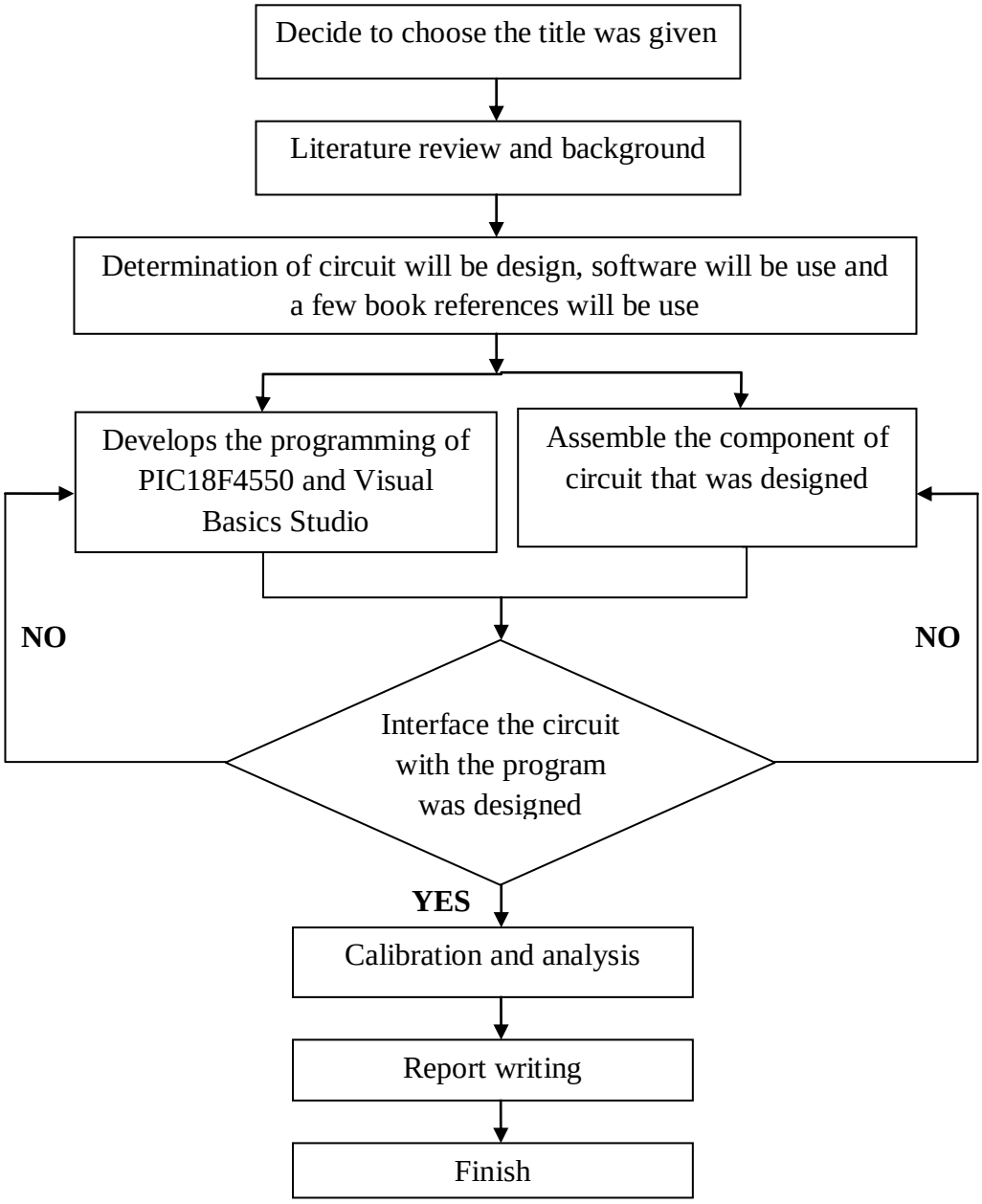

Figure 1.0: Flow chart developing of project

After the title announced, student should select one of the title, but before they decide to choose that title, student must be able really understand the title by doing a few research about this title. They must understand what the title covered either include the hardware part or software or both. From this research, they will understand what the project actually and will easier the student to run for next step. After know what this

project about, they can decide either they want proceed or change the title to make sure they can finished this project.

Then, when title was decided, further literature review must be doing to get some information in order to plan the project. For this project, it involved there are many theories, solar system, direct current(DC) system, circuit theory and a lot of programming system. This project also involves hardware, so the research also needs to select the electronic component and designing the circuit.

After get all information needs, this project decide to use current sensor, voltage sensor, PIC18F4550 and Visual Basics Studio as core of this project. And some references book selected as guidance for this project.

After designing the circuit finished, all the electronic component need to assemble.

After circuit assemble, PIC18F4550 programming need to design. This programming involves assembly language then that assembly language need to burn into PIC18F4550. And for Visual Basics Studio Software it use C language programming.

After all hardware part and software finished, both part needs to interface together. Both part must be work as the planning, if not, troubleshooting skills need to apply to check either redesign the programming or check the circuit design. This step will be repeating until it can function as well. That is the most difficult step in this project.

Then, for the analysis and calibrating part, this system will be resetting according to the real time function to make sure that what the system measure is same with the real value. For this step, digital multimeter will be use to calibrate.

After all step above has been finished, report for this project must be finish before submit this project to the advisor.

Operating of this system has been summarized like the block diagram below

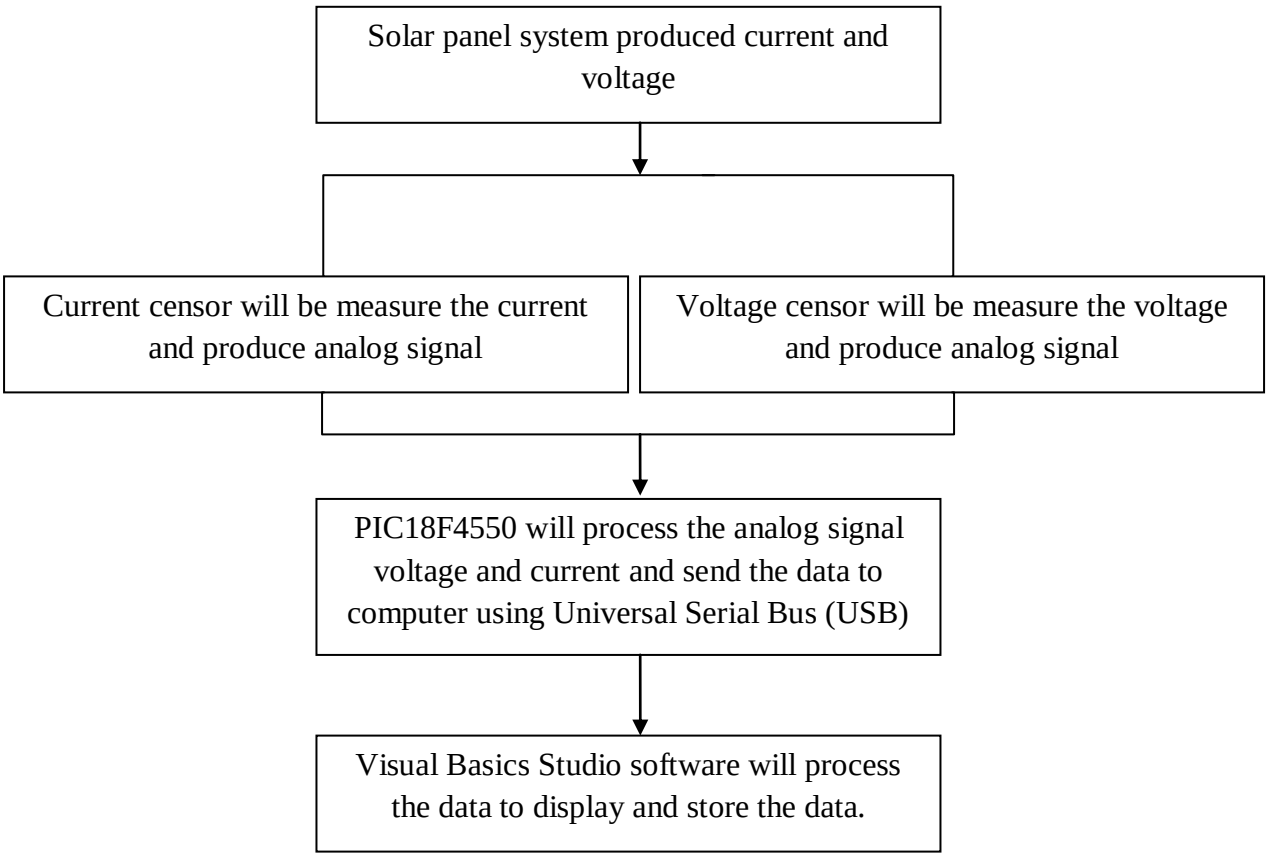

Figure 1.1: Flow chart system flow

Description:

Solar panel will generates electricity energy from light and radiant from the sun. This solar panel has capacity to produce about 80 Watt. Then this energy will determine in voltage and current that has 20.0 V rated voltages and 1.0 A rated current. Both of this voltage and current will be flow to the voltage and current sensor.

Current sensor will sense the current in analog signal then it will convert to the digital signal the highest limit of this sensor is 1.0 Amp. And for the voltage value, it will sense the voltage that produce by solar panel in analog signal before convert to digital signal using voltage divider voltages and maximum sense voltage is 20 V. These two sensors will send the information to the analog input of PIC18F4550.

PIC18F4550 is the heart of this system actually. The programming stored in this PIC18F4550 function as command how this PIC operates. With that programming, analog input from both of sensor can be process in this PIC18F4550, it will convert into digital signal before send to USB and this PIC18F4550 will control the data that will send the USB port.

From the USB port, Visual Basics Studio will analyze and determine what data that will be display, the voltages and current and power value will be display in GUI Visual Basics Studio. Visual Basics also will make database for that value every one hour for future analysis. This database can be recall anytime by any user.

No	Progress	WK 1	WK 2	WK 3	WK 4	WK 5	WK 6	WK 7	WK 8	WK 9	WK 10	WK 11	WK 12	WK 13	WK 14	WK 15
1	Title selection	■														
2	Literature review		■													
3	Understanding project		■	■												
4	Proposal preparation			■	■											
5	Submit proposal					■										
6	Seminar 1						■									
7	Report writing							■	■							
8	Logbook Writing	■	■	■	■	■	■	■	■	■	■	■	■	■		
9	Submit report													■		
10	Submit logbook													■		
11	Analysis preparation PSM II														■	■

Table 1.0: Gant Chart of the project schedule for semester 1

No	Progress	WK 01	WK 02	WK 03	WK 04	WK 04	WK 05	WK 06	WK 07	WK 08	WK 09	WK 10	WK 11	WK 12	WK 13	WK 14
1	Hardware design	■	■	■	■	■	■									
2	First draft thesis writing	■	■													
3	Submit first draft thesis		■													
4	Software design			■	■	■	■	■								
5	Second draft thesis writing				■	■										
6	Submit second draft thesis						■									
7	Finalize project							■	■	■	■					
8	Prepare presentation and demo											■				
9	Submit abstract, slide and demo												■			
10	Presentation and demo													■		
11	Prepare final thesis														■	■
12	Submit complete thesis and logbook															■

Table 1.1: Gant Chart of the project schedule for semester 2

CHAPTER 2

THEORY AND LITERATURE REVIEW

2.1 Introduction

This chapter includes the study of solar photovoltaic (PV) panel system and the type of measurement of voltage and current produced. Before start any project deep analysis needed to understand basic function of the system. In this project, study about the generating the current and voltage is needed. From that analysis, appropriate device can be selected or design to deal with project function.

The objectives of this chapter are:

- To know the basic generating the electricity energy from solar panel
- To analyze the problem from previous electricity energy monitoring
- To select the appropriate device or circuit to deal with this project.